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Index Vol. X.

Water Power Situation in Canada, J. B. Challies, M.Can. Soc. C.E. 1
Shell Manufacture in a General Engineering Plant 4
A Southern British Columbia Power System, V. S. Goodeve 18
The Mechanical and Electrical Club of the Engineering Society 20
Reunion of Montreal Toike Oikes 24
Farewell Dinner to Members of Class 1913 24
C.O.T.C. Camp 25
The Modern Terror of the Deep 37
German Incendiary Bombs 50
The Heat Treatment of Steel, T. R. Loudon, B.A.Sc., A.M. Can. Soc. C.E. 52
Modern Military Explosives, J. W. Bain, B.A.Sc. 61
The Work of the Engineering Society of the University of Toronto, and Its Co-operation with the Faculty of Applied Science, Dean W. H. Ellis, M.A., M.B. 65
Shrapnel 66
The Scleroscope, R. J. Marshall, B.A.Sc. 71
The Manufacture of Munitions in Canada 73
University of Toronto Club of New York 74
A New Thread Milling Machine 75
Radiator Traps and Test Data, L. M. Arkley, M.Sc. 83
Minor Details in an Engineer's Career, J. H. Kennedy, O.E., O.L.S. 94
New Tygard Engines for Improving Submarine Service, J. W. Tygard 97
Value of Economics and Business Training to the Engineer, E. W. Stern, M.Am. Soc. C.E. 99
Combined Mixer and Road Roller 100
Buffalo Extension and Reclamation, T. K. Thomson, D.Sc., M.Am. Soc. C.E. 101
Increased Production in Canada, W. B. McPherson, B.A.Sc. 107
A New Radiation Trap 111
The Engineers 112
The University and Industrial Research, Dean W. H. Ellis, M.A., M.B. 121
Retiring President's Address 125
Engineering Alumni Association 129
Ottawa Alumni Association 130
Inter-Collegiate Debating 131
A Psalm of Life at S.P.S., A. T. C. McMaster 132
How Canadians Join the Aviation Corp 134
Our Response to the Empire's Call 135
On Active Service 138

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TRANSACTIONS OF THE UNIVERSITY OF TORONTO
ENGINEERING SOCIETY

Old Series Vol. 27 TORONTO, MAY., 1915 New Series Vol. X. No. 1

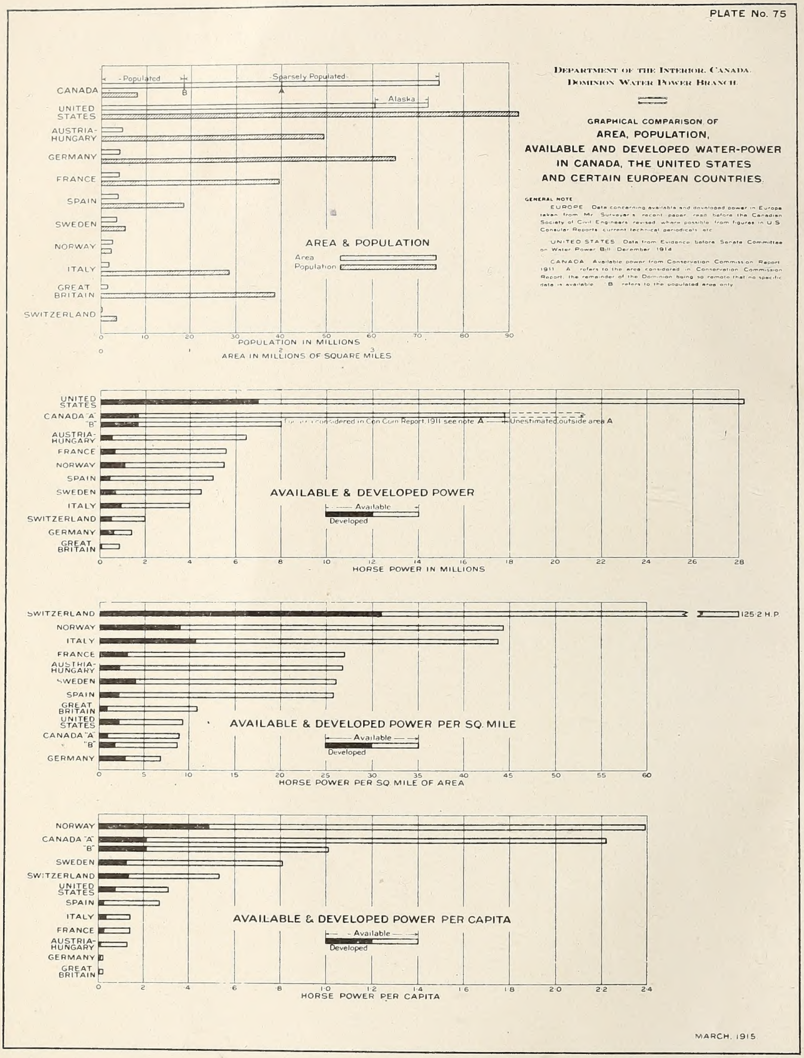
THE WATER POWER SITUATION IN CANADA

Exceedingly Advantageous Location of our Falls—Greatest Per Capita Development Except Norway—Greatest Total Available Except United States.

By J. B. Challies, '03, M. Can. Soc. C.E.
Superintendent, Dominion Water Power Branch

A survey of the water power situation in the different countries of the world shows that Canada, the youngest of them all, has accomplished more in actual development and in use, than any except, perhaps, Norway. The outstanding feature of the power situation in Canada is the exceedingly fortunate and advantageous location of our water powers from the Atlantic to the Pacific. Practically every large city is to-day supplied with all the hydro-electric energy it can use from water power, the sources of which can be extended to meet all anticipated demands. Where the source of power is not water power, as in the middle western prairies, there is an abundance of either gas or good steam coal within immediate reach. There is probably no part of the present settled portions of the Dominion where power cannot profitably be produced from wholly Canadian sources. In cases of necessity we can be, and in time we shall be, independent of all foreign power-producing agencies.

All substantial and reasonably necessary power requirements throughout Canada have been met and provided for, and much pioneer work has been accomplished in adapting hydro-electric energy to new and highly profitable industrial use. In fact, the water power situation strikingly demonstrates the faith of Canadians in our vast heritage. We have been extending an ever-widening net-work of transmission lines over our far-flung territories so that to-day, measured by population, we have the highest ratio of water horse-power of any other nation except Norway. On the other hand, as suggesting the room still left for expansion, we have the lowest ratio of water horsepower in proportion to area. The progress of power development in Canada has, so far, been based on sound engineering and sure economic principles, and there have, therefore, been very few financial failures. This has resulted in the



DEPARTMENT OF THE INTERIOR, CANADA.
DOMINION WATER POWER BRANCH.

GRAPHICAL COMPARISON OF
AREA, POPULATION,
AVAILABLE AND DEVELOPED WATER-POWER
IN CANADA, THE UNITED STATES
AND CERTAIN EUROPEAN COUNTRIES.

GENERAL NOTE

EUROPE. Data concerning available and developed power in Europe taken from Mr. Surveyer's recent paper read before the Canadian Society of Civil Engineers revised where possible from figures in U.S. Consular Reports, current technical periodicals, etc.

UNITED STATES. Data from Evidence before Senate Committee on Water Power Bill, December 1914.

CANADA. Available power from Conservation Commission Report 1911. "A" refers to the area considered in Conservation Commission Report, the remainder of the Dominion being so remote that no specific data is available. "B" refers to the populated area only.

The Water Power Situation in Canada and other Countries popular delusion of the great potential value of undeveloped water powers, and in some districts in the general public being unduly apprehensive of the profits and powers of public utility corporations which control or develop existing water powers.

The great importance of our power resources, their successful adaptation for industrial use and for furnishing so much of our modern comfort, has resulted in the general public taking a very marked interest in all questions pertaining to water power administration, investigation and use, and the question of suitable legislation covering water power administration and authorization has become one of the most important legislative topics in Canada.

On the whole we are exceedingly fortunate in Canada, especially when we compare our conditions with those of the United States. Our water power laws are, in the main, quite adequate; encouraging to development with due regard to the public interest, present and future. While in some parts of Canada we may have outgrown former conditions and in such parts governmental machinery and laws with respect to water powers have not advanced as fast as might be desired, it must be remembered that there is but a short distance in time from the 50 h.p. overshot mill wheel of small efficiency and crude apparatus of local use and of little general importance to the community at large, to the 20,000 h.p. turbine of over 90 per cent. efficiency and 200 mile transmission line of to-day, of such widespread importance owing to the present universality of the electrical industry. In a very short time it is probable that legislators in all parts of the Dominion will have realized the advantage of and have put into force an efficient water power administration providing reasonable laws under which water power development will be fostered with due protection to the public interest.

In the lull which has temporarily supervened in power development in Canada, we can look back with satisfaction upon a long period of uninterrupted prosperity and marvellous expansion. This lull should enable the Dominion and Provincial Government Department, interested in water power matters to perfect their arrangements for securing that physical and economic data which is always essential and a necessary preliminary to the financing of new water power developments.

While in the past there has been a great lack of reliable data regarding Canadian water powers, there is now much excellent work under way throughout the Dominion which if continued and extended without delay, will result in sufficient data being obtained regarding all powers within transmission radius of present or prospective commercial centres being available for consideration when the present financial stringency is relieved.

It has been said that the use of power in Canada for electro-chemistry, electro-metallurgy, and electro-siderurgy, has not kept pace with the advance made in these arts in other countries, and on the other hand that certain European countries are using about one-half of their developed water powers for these latter purposes. It must be admitted that most of the developed power in Canada is used for motive power, traction and lighting, and but a small percentage for electro-chemistry, electro-metallurgy, and electro-siderurgy. This condition of affairs is probably the result of a young country first, meeting its most urgent permanent and "primitive" power requirements, that is, for lighting, traction and motive purposes, and to temporarily postpone the extensive and intensive adaptation of power for electro-chemical and electro-metallurgical purposes; at any rate until adverse economic conditions and financial hazards surrounding the use of power for such purposes have been overcome. One thing certain, no country in the world has realized greater benefit from the advantages of hydro-electric power for domestic, municipal and manufacturing purposes, than have the people of the Province of Ontario, thanks to the Hydro-Electric Power Commission of Ontario.

In a general way any considerable extension to existing power plants and the development of additional water powers in Canada must depend primarily upon the demand for power from traction, lighting, and motive power sources, and but secondarily on the possible use of power for electro-chemical, electro-metallurgical, and electro-siderurgical purposes; of course the use of power for pulp-making alone excepted. Unless we use our power to supply the ever-increasing demand from our southern neighbors in the United States, the first use of power will grow directly with the increase in our population, slowly and steadily at any rate for the next decade. For any considerable increase in our present power demand, except power required for pulp-making, we must depend largely on proving the commercial possibilities of the use of power for electro-chemical and electro-metallurgical purposes.

SHELL MANUFACTURE IN A GENERAL ENGINEERING PLANT*

Perhaps the most fortunate of the various manufacturing institutions in its ability to readily take over the shell business is the general engineering plant. The equipment usually requires comparatively slight alteration, and there are also at hand the type of men and scope for designing and building any necessary special apparatus at short notice

The unexpected change of employment of the greater number of Canada's metal working plants from the production of articles of peaceful commerce to the fabrication of munitions of war has been done at more or less sacrifice depending largely upon the character of the plant. The methods herein described for the manufacture of shrapnel shells are those adopted by a plant whose regular equipment is unusually well suited to the different processes involved. The product for which original machines were installed consists of internal combustion engines in large quantities, and it will be interesting to note the great similarity in the various operations required to those of the more warlike output at present being produced.

---

* From Canadian Machinery, Toronto.

The shells are received at the plant from the steel works in the form of rough forgings. They are unloaded from the cars in a well equipped shipping department on to an auto-car operating on an industrial railway and by means of which they are transported to the shell department beside the machines which perform the first operation—the trimming of the open end. These include a cutting-off machine with two tools and variable feed, a John Hall & Sons Brantford pipe machine and a heavy standard lathe. The gauging point for this as well as subsequent operations is the bottom of the shell chamber inside.

Use of Milling Machines

The basing or rough facing of the closed ends is done most efficiently upon an Ingersoll four-spindle milling machine, using the two vertical spindle heads. The plates of the machine carries four fixtures located in pairs near either end. These fixtures hold twelve shells each, arranged in two rows of six. The shell is simply dropped over a vertical gauge pin and is clamped, two shells to a clamp in an upright position.

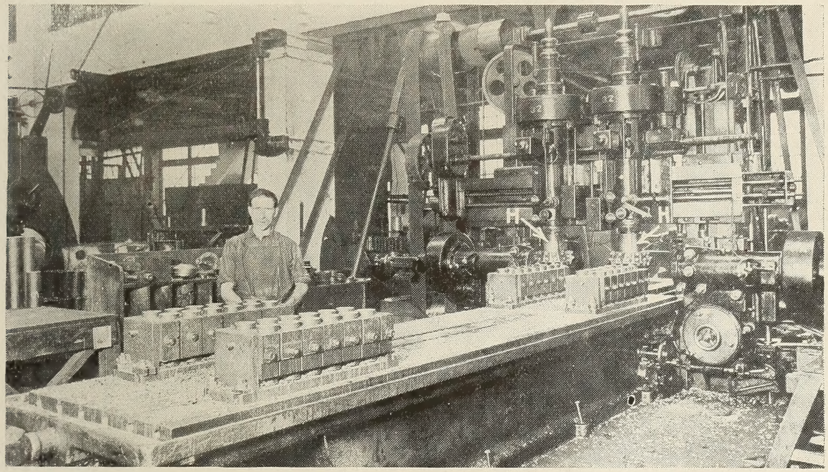


Fig. 1. Continuous Milling of Bases on Ingersoll Multiple Spindle Machine

The milling is done by two large, inserted tooth high speed steel facing cutters, one traversing each fixture. While one pair of fixtures is under the cutters, the operator is engaged, at the other end of the table, in emptying and reloading the other pair of fixtures so that the milling process is practically continuous. This has proved a most satisfactory method of doing this part of the work as the machine is powerful and rigid enough to work the high speed steel cutters to their capacity. Another machine of this type is being fitted up and will be in operation shortly.

After gauging for length, the forgings go to the various machines utilized for the outside turning. For this purpose the shells are driven upon mandrels solidly attached to the face plates of the machines. These arbors are solid and are fitted, upon the shank part, with a circular nut. When it is desired to remove the work, this nut is simply tightened against it and a tap with a hammer upon the side serves to release it instantly.

The turning is done on two Bertram and two Bullard vertical turning and boring mills, one Conradson turret lathe, one Gisholt, two heavy Steinle turret lathes and one Pratt & Whitney turret lathe. The Steinle machines are equipped with a special expanding arbor and are used to turn such shell forgings as come slightly large so that they cannot be tightly driven on the solid arbors. The gripping points consist of twelve pins in four circles of three each which are moved outwards against the shell chamber by the wedge action of the spindle which is actuated by a nut at the rear end.

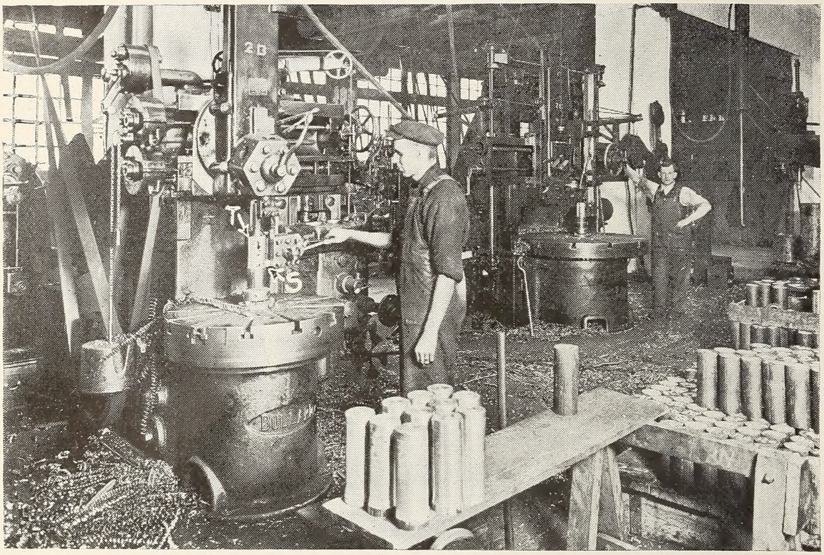


Fig. 2. Rough Turning Shell Forgings on Bullard and Bertram Vertical Turrets

It is interesting to note that, in quantity of production, the competition between the several machines is rather close, the Steinles coming first, the Pratt & Whitney second and the vertical boring mills third, although the difference does not amount to more than from six to a dozen per day.

The series of operations consists of rough turning the shell body, finish turning from the band to the base, finish facing the base and roughing out the groove for the band. The work on the groove here consists of cutting down the whole width to the top of the vees of the wave and of cutting down the two edges to the bottom of the vees. The rough turning of the body is carried up to the edge of the part which is nosed in, or, in other words, it involves the cylindrical part of the shell.

Boring Processes

The next operation consists in boring the shell in the bottom to receive the powder cup and also for the seat of the steel diaphragm which separates the powder from the bullets. This is also carried out on a number of machines of a widely varying nature. These include a Conradson turret lathe, a four-spindle Foote-Burt drilling machine, a Bertram horizontal boring machine, and others. At first sight, the latter machine appears extremely clumsy, and heavy for such work, but such has not actually proved to be the case. The rigidity of the machine and the abundance of driving power make up for a great amount of inconvenience and, what was at first a mere attempt to get something out of the machine and to keep it going has proved to be one of the best single spindles on the job, an output of 90 shells being obtained per eleven hours.

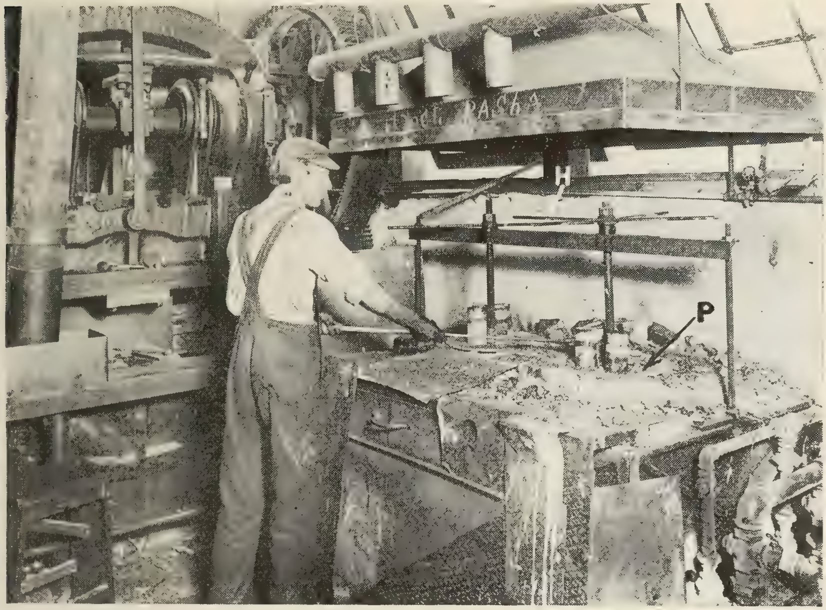


Fig. 3. Nose-heating Furnace and Nosing Press

The multiple spindle drill, while being a very satisfactory machine in point of simplicity of operation and quantity of output, cannot be readily arranged to do the facing of the end; this, however, is done on a small machine not large enough to do the boring. The boring tools used consist of two solid bars equipped with flat formed cutters, one for roughing and one for finishing. These cutters or bits possess the advantage of being easily made in numbers, and dull cutters can be quickly replaced by sharp ones without materially interfering with the progress of the work. The Foote-Burt machine operates two roughing and two finishing spindles continuously and is handled by two men.

The next operation is that of waving. This consists of turning in the bottom of the groove for the copper band a pair of inverted vees to prevent the band from turning on the shell as it traverses the length of the gun, so called because the vees are cut, not on a flat but on an undulating plane. The waving is accomplished by a square nosed tool with two vees of the correct dimensions cut in the face of it.

An interesting tool making question here arises as in order that the angle of the vee be correct on the sloping parts of the wave, the angle of the groove in the tool must be greater. The lateral oscillating motion is given to the tool by a face cam fastened to the face plate of the lathe. The work is done on two R. McDougall and two Bertram geared head lathes, equipped with special centering chucks which grip the work by the turned body. The cam roller is fastened rigidly to the lathe carriage and is held to the face of the cam by a suitable weight. After waving, the open ends are turned for heading on a small lathe by hand feed the purpose being simply to true up this part of the shell, and only enough is taken off to accomplish this.

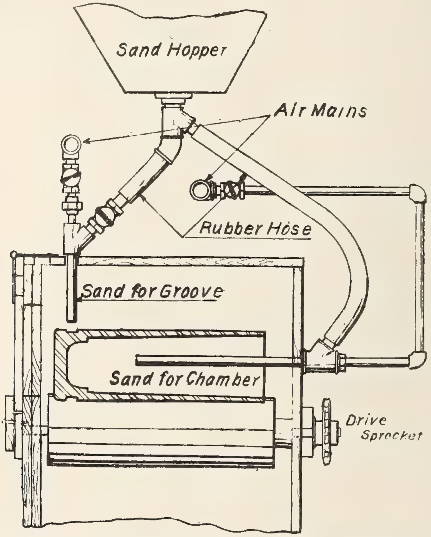


Fig. 4. Detail of Sand Blasting Machine

HEAT TREATMENT

The shells come to this department placed on end in large trays, open ends up, each tray holding 120. A boy now paints the bases and grooves of the shells with a mixture of whiting and alcohol to prevent oxidation of the finished parts during heating, and returns them to the tray closed ends up. For heating the shells, six lead baths are employed, the warming and final heating taking place in separate baths. These pots are heated by oil burners and the temperature regulation is maintained by electric pyrometers. The work is heated for about half its length, and, to accomplish this, it is held in a vertical position by the circular cover plate of the bath which contains four suitable perforations to receive the shells which are held down by a conveniently placed weight.

The hardening is accomplished by dipping in oil, three tanks approximately 4 ft. by 2½ ft. by 2 ft. being used. The dipping is done with the open end of the shell entering the oil at an angle of about 45 degrees and is quickly reversed so that the base turns downwards. After chilling the shells are inverted upon hooks placed at the back of the tank to drain and are subsequently removed, cleaned and tested for hardness. For this, the well known scleroscope is used. The test must be applied at a specified distance from the end of the shell and at least three points in its circumference. A feature of the use of the scleroscope for this work is the rapid wear of the bulbs. Unless the very best quality is obtained these wear out at the rate of about one per day.

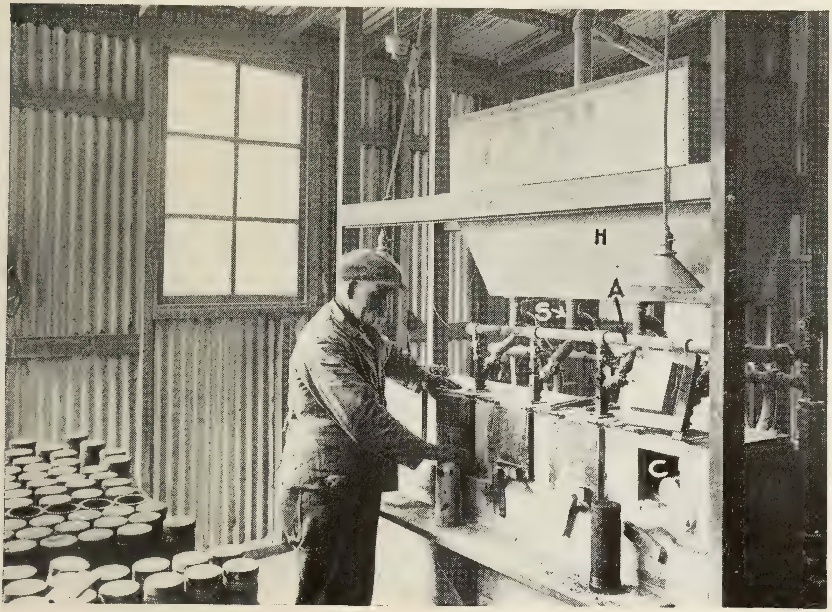


Fig. 5. Sand Blasting Machine which cleans Powder Chamber and Band Groove

The next step in the process is sand blasting the groove and the inside or powder chamber. This is accomplished by means of a very simple and most ingenious machine, devised and built by the Canadian Fairbanks-Morse Co. The apparatus consists of four compartments each just large enough to accommodate a shell and is closed by a wooden door. The shell rests upon a pair of live rollers so that it rotates continuously. One nozzle enters the open end and directs its flow of sand at the internal surfaces to be cleaned while another in a vertical position cleans the groove and its undercutting. There are, of course, four pairs of nozzles and the process is completed as fast as one man can handle the shells.

The forming of the nose is done on a heavy geared stamping and forming press. The furnaces used here are worthy of note. These are the usual oil heated lead baths covered with circular plates containing four openings to hold shells in the proper vertical position. The plates are connected to vertical spindles provided with four arms at the top so that, as a hot shell is removed and replaced by a cold one, the disc plate can be rotated a quarter turn to bring a fresh hot shell into position for the press man. The shells after nosing are allowed to cool slowly.

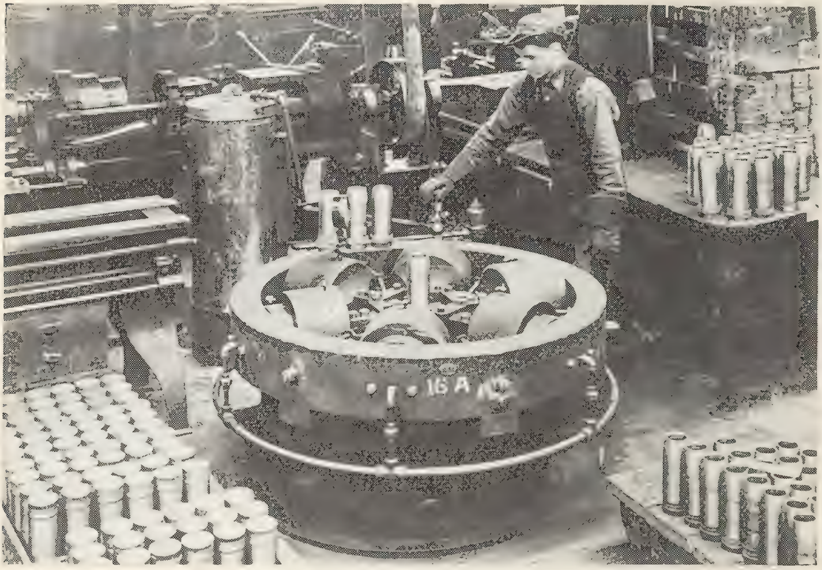


Fig. 6. Canadian Fairbanks-Morse Branding Press

The final operation on the base of the shell consists of cleaning and polishing on a rag wheel to remove all signs of the heating operations. The machining of the nose constitutes another series of operations, the first of which is the rough turning of the outside. This is accomplished by means of a plate carrying a cam slot and attached rigidly to the bed of the machine. This slot effectively guides the cam roller which is rigidly connected to the lathe cross slide and thus restricts the motion of the tool so as to give the correct contour to the shell nose.

The roller is held securely to the guiding face by weights and the feed of the tool is regulated by stops, a solid plate gauge being used to test for size over all. The nose is bored in the same way after grinding with an ordinary diamond point tool held in a short stout boring bar. The lathe carriage is guided in a cross-wise direction by means of a cam attached to the rear of the lathe bed as before.

The finish facing and tapping are done by turret lathes, a solid tap being used which is backed out by reversing the lathe spindle. The shells are now ready for grinding for which three Norton grinders are used The finishing of the shells by grinding is considered a success in every way by the management of this plant and they have deviated but little in their methods from standard practice.

The shells are centred by chucking at the rear end and by means of a plug carrying the centre at the front end. The machine is traversed in the usual way in grinding the cylindrical part of the work and a formed wheel is used only to finish the profile of the nose. Two plain grinders and one formed wheel grinder handle the output of the plant. The diamond problem is overcome by avoiding, as much as possible, wide formed wheels and the men in charge express themselves as well satisfied with the results. Following the grinding, the inside of the nose is turned to size and the shells receive their preliminary shop inspection in which particular attention is given to the undercutting and waving in the groove for the band. After this the shells receive their first government inspection which follows somewhat similar lines to the shop inspection.

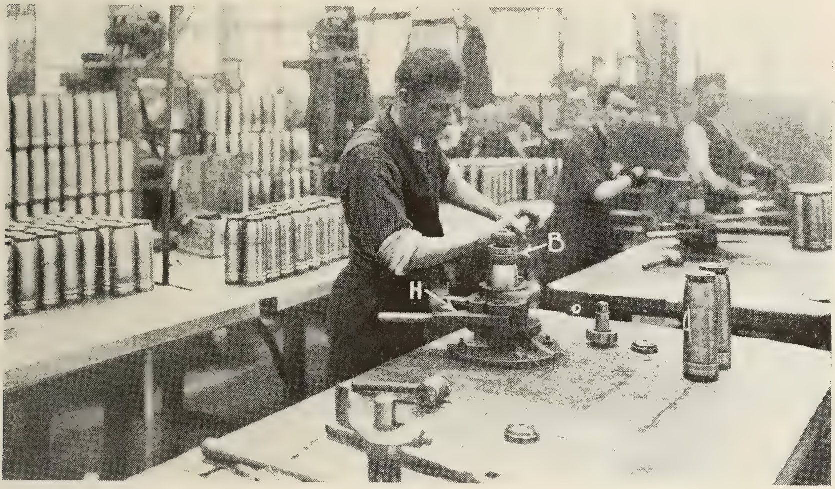


Fig. 7. Shell Vise and Ball-bearing Plug for Screwing Down Socket

Banding Operations

The work in connection with the copper rotating band consists of a series of operations. The marking is done at this point upon a Holden-Morgan marking machine and the bands are crimped in place by means of a hand lever press which sets it down into the groove at four points in the circumference. The banding press is of the hydraulic six-cylinder type, built by the Canadian Fairbanks-Morse Co. So successful has this press been that the company has undertaken its manufacture, and has sold a considerable number to other people engaged in the shell business. The machine is operated by a belt-driven pump, and has a number of interesting features. The shell is placed, open end uppermost upon a small plate at the centre with the pistons working radially towards it, and the band is pressed home in two operations between which the shell is given an eighth of a turn so that the entire circumference is affected. The press is quick acting and the entire operation requires less than one minute.

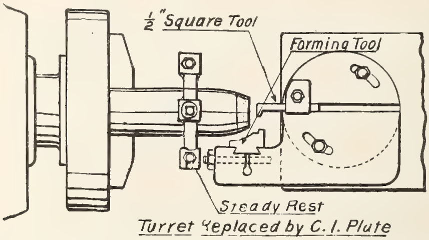


Fig. 8. Fox Turret Lathe with Turret Replaced by Set-up for Finishing Sockets

The turning of the band is done on small lathes using flat formed tools. The main tool is situated on the carriage in the usual place, while a smaller tool located in the centre of the carriage, so as to operate on the bottom of the work when the cross feed is reversed, is used to turn the flat parts of the band. A brass plate which acts as a rest for a hand tool is now slipped over the main forming tool and all burrs and ragged edges are removed from the turned band in this way.

Assembly

The case of the shrapnel may now be considered finished and only requires assembling with the interior parts. These consist of the tin powder cup, the diaphragm, a brass tube leading down through the centre and which screws into the diaphragm, the bullets and rosin matrix, the cap and plug, and several bits of muslin solder, etc. The first operation consists of placing the tin powder cup beneath the steel diaphragm which was placed in the shell previous to the nosing operation. The tubes are now screwed in place and a felt plug upon the end of a wire is inserted to prevent all particles of material or foreign matter from entering the tube or the powder

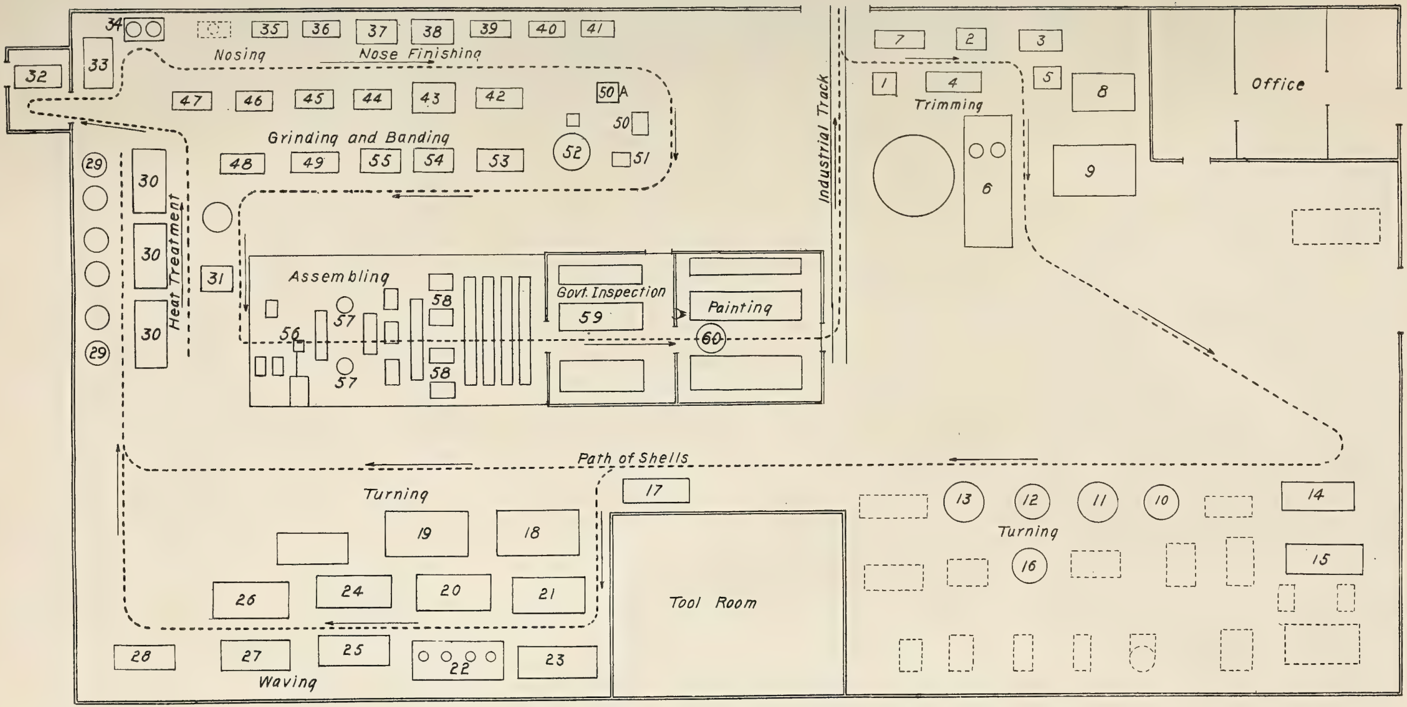


Fig. 9. General Layout of Plant Illustrating Path of Product and a Most Efficient System

SEE NEXT PAGE

case. This stopper remains in place until the completion of the assembly.

The bullets are stocked above on the gallery of the shop and come down to a filling trough by gravity through a tube in the same way that the diaphragm discs come down to the nosing press. This saves a considerable amount of floor space at points in the plant which are of necessity very much congested. The spout delivers to a trough at the end of which is a filling device especially designed to deliver the bullets to the shell in a steady stream rather than in a mass. It has been the experience of the officials of this plant that this is a most important point as the space cannot be perfectly filled by the bullets if these be dumped in bodily.

To insure the bullets being thoroughly packed, the shell rests

---

GENERAL LAYOUT OF PLANT ILLUSTRATING PATH OF PRODUCT AND A MOST EFFICIENT SYSTEM

Trimming

1—Pipe machine.
2—Rogers bolt cutter.
3—Bertram lathe.
4—Niles lathe.
5—Hall bolt cutter.
6—Ingersoll miller.
7—Bertram lathe.
8—Ingersoll miller.
9—Double spindle boring machine.

Boring

14—Horizontal boring mill.
15—Horizontal boring mill.
21—Conradson turret.
22—Foote-Burt 4-spindle drill.

Waving

24—American lathe.
25—Bertram lathe.
26—American lathe.
27—Bertram lathe.

Turning

10—Bullard mill.
11—Bertram mill.
12—Bullard mill.
13—Bertram mill.
16—Bertram mill.
17—American turret.
18—Steinle turret.
19—Steinle turret.
20—Pratt & Whitney turret.
23—Gisholt lathe.
28—Small lathe—turn for nosing.

Heat Treatment

29—Six Fairbanks-Morse oil furnaces.
30—Three oil tanks.
31—Scleroscope.
32—Fairbanks-Morse sand blast machine.
33—Nosing press.
34—Fairbanks-Morse furnace.

Finish Nose

35—Lathe, tap and face.
36—Lathe, tap and face.
45—Lathe, tap.
46—Lathe, turn profile.
47—Lathe, turn profile.
48—Lathe, turn profile.

Grinding

37—Norton grinder—grind body.
38—Norton grinder—grind body.
43—Norton grinder—grind body.
44—Norton grinder—grind profile.
39—Lathe, bore nose profile.
40—Lathe, bore nose profile.
41—Lathe, file profile when necessary.
50—Marking machine.
50A—Washing machine.

Banding

51—F.-M. hand press—set band.
52—Fairbanks-Morse banding press.
53—Small lathe—turn band.
54—Small lathe—turn band.
55—Small lathe—turn band.
49—Small lathe—turn band.

Assembling

56—Bullet spout.
57—Rosin pots.
58—Four Fox-turret lathes, turn socket.
59—Inspection benches.
60—Fairbanks-Morse painting machine.

during the process upon a vibrator plate which vibrator is very similar to that used on matched plate moulding machines. Short, rapid motion has been found to give better results than a longer and slower motion. The correct number of bullets is ascertained by weighing after which the shells go to the rosin pots. The bullets are not heated as is done in many plants, this being considered unnecessary if due care be exercised in the pouring of the rosin and in maintaining it at the proper temperature. Experience and the making of sections of a number of finished shells have amply borne out this practice in a very satisfactory manner.

After filling, the shells are again corrected for weight and are ready for screwing in the sockets. For this purpose, the case is firmly held in an upright position by a special vise operated by a lever and cam. The threads and seating parts of the socket are first luted with shellac and then screwed home by means of a special ball-bearing driver and a large, single-ended tap wrench. The plug used for this purpose is a very simple and efficient affair. It consists of the squared shank and a straight, threaded portion of the same diameter and pitch as the inside threaded part of the sockets. Upon the upper part of the thread are two hardened steel nuts fitted with grooves on their adjacent sides to form the raceway for a ball bearing B. The bottom nut seats against the socket to be screwed in and is jammed by the upper nut on account of the much greater friction in the thread bearing than in the ball bearing. For the same reason, the backing of the wrench instantly releases the plug from the socket from which it can be unscrewed by hand.

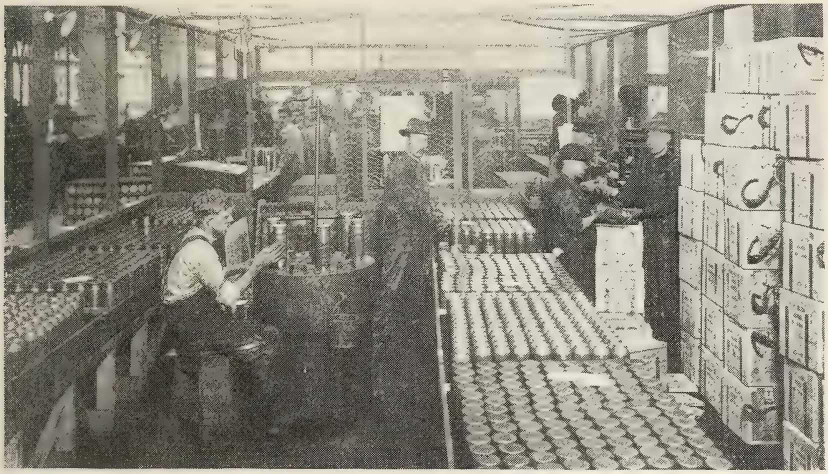


Fig. 10. Painting, Final Inspection and Crating

The tube is soldered to the socket by means of a special copper formed in the shape of a ring of the right size and provided with a groove on one side to allow the escape of air. The solder is used in the form of wire which is first coiled and then cut into rings, no acid being permitted in the process.

Finishing the outside of the socket in conformity with the general contour of the shell nose is done on four small lathes equipped with formed tools and steady rests. These lathes remove all surplus solder and in doing this perform the last manufacturing operation upon the shells. The latter now receive their final shop inspection and are passed on to the officials of the government for their final gauging and inspection. Upon their being passed and the receipt of favorable report from the firing test, the shells are painted to prevent deterioration by weather conditions.

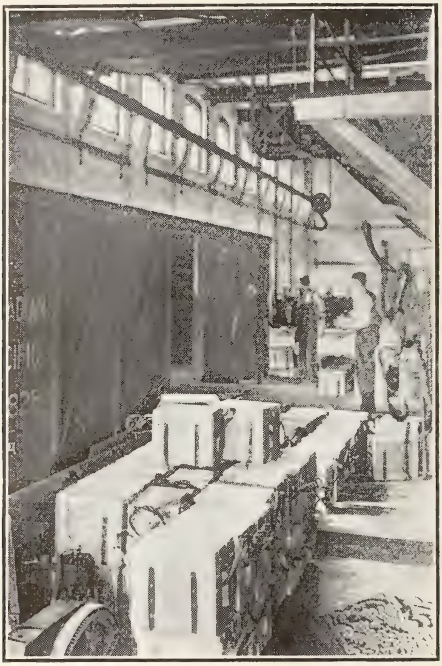


Fig. 11. Shipping and Receiving Department—Loaded Industrial Motor Car.

TESTS

It will be remembered that, at the preliminary inspection, two were chosen from each series of 120, one of which was to be prepared and sent to the arsenal for the firing proof and, from the other, a section is to be cut out as designated by the inspector for the preparation of a specimen for the tensile test of the steel. The shells are painted on a very ingenious machine designed and built by the Canadian Fairbanks-Morse Co. This machine, like the banding press, is being constructed in numbers and sold to other shell manufacturers. It contains six vertical spindles spaced evenly about a flat circular table. These spindles are kept in constant rotation at a speed of about 250 r.p.m., by a motor at the base and which receives its current through a lamp socket from the ceiling. The shells are placed in an inverted position upon the upper ends of the spindles, the friction being amply sufficient to drive them with the necessary force. The painting is done with a flat pad from paint receptacles conveniently attached to the machine. The table revolves upon ball bearings and the whole is on wheels so that it can be readily moved to the work. The time required for the painting is one minute per shell for the three coats as specified by the government.

The shells are removed from the machine with a special holder that grips them by the copper band and are placed in racks to dry. After the painting is completed, the shells are finally inspected and packed in wooden cases holding six each. These are loaded upon an industrial railway car and taken to the shipping department whence after inspection of the cases, they are loaded into railway cars two tiers high and start upon their long journey to France, and after loading with the powder charge and primer, to the battle fields.

System a Factor

The most striking point in connection with this plant is the evident perfection of the system employed. From the moment the forgings reach the plant, not a backward movement is made. The flow of shells through the plant is smooth and uninterrupted and at no point do the streams cross over. The result of this is evident. Foremen and superintendents are conspicuous by their absence in the shop and are to be found in the office attending to business.

The transfer truck and pyramid system is used almost entirely and the shells are unloaded upon the floor only where absolutely necessary. Another striking feature is the utilization of all the machinery of the plant, both great and small, the devices to this end being in many cases original.

The company has bought little, if any, outside machinery. On the contrary, the special machines required have been designed and built within the plant and many have been sold to outsiders. The co-operation of Canadian manufacturers in assisting each other in this and in other ways has not only been the surprise of the business to foreign companies, but has been, perhaps, the greatest factor in the successful handling of this great work by Canadian financiers and manufacturers.

A SOUTHERN BRITISH COLUMBIA POWER SYSTEM

By Vincent S. Goodeve, '10

Many people in the Eastern provinces of our Dominion are inclined to regard British Columbia as a comparatively new and undeveloped province. Yet, as far back as 1897 gold and copper mining and smelting had reached such a stage as to cause far-seeing men to begin the construction of a hydraulic power plant to supply the promised market. I refer to the West Kootenay Power & Light Co., from whose system nearly all of the mining and smelting industries of what is known as the Kootenay and Boundary countries, are supplied with power. Much of the ore in these districts is of such low grade as to require a good supply of cheap power in order that the ore may be handled in sufficient quantities to render its mining and smelting profitable.

In 1908 the company were supplying power from their first plant situated at Lower Bonnington Falls on the Kootenay River about ten miles from Nelson. The available load at that time was 1,000 h.p. at the end of a 32 mile transmission line. That the venture of the company was justified is evidenced by the fact that this original plant of 4,000 h.p. capacity is now used as a stand-by while their second plant at Upper Bonnington Falls, about one mile from the first and of 16,000 h.p. capacity, together with No. 3 plant at Cascade City on the Kettle River and of 3,900 h.p. capacity, are required to supply the present load. No. 2 plant was completed in 1907, and in the same year the company took over the system of the Cascade Water, Power and Light Co., including what is now the No. 3 plant, which was supplying power in the Boundary country but which had not the capacity to supply the increasing demand. Forthwith, the Bonnington power was extended into this country and arrangements made whereby either source may be utilised to supply a limited supply of power to the other system in the event of a breakdown or shutdown for any cause.

The transmission voltages and places supplied from the various plants are as follows:—

No. 1 plant—Dead, and its customers supplied by special transformer in No. 2 plant, transmitted at 22,000 volts to Rossland, Trail and Silver King Mine.

No. 2 plant—60,000 volts supplied to Rossland, Grand Forks, Phoenix, and Greenwood.

No. 3 plant—22,000 volts, supplied to Grand Forks, Phoenix, Greenwood and Boundary Falls.

All current is transmitted at 60 cycles and stepped down to the prevailing distribution voltage, usually 2,200 volts, at the various substations.

Someone has rightly said that if the province of British Columbia were flattened out it would have twice its present area. The building of a transmission line in such a country is not an easy task. The power must go wherever the mines and smelters are located. The smelters must be built wherever the character of the land and the railroad facilities will permit. These conditions lead the power lines over rough land to altitudes of six thousand feet and down again to two thousand feet. The patroling and repairing of such a line is an expensive matter, and the company found it better to build a line requiring very little attention but costing more than the flimsier line. The 60,000 volt line is a model in this respect and its 84 miles of duplex three phase line give remarkably little trouble. It is also remarkably straight considering the character of the country through which it passes. The heavy cedar poles are spaced only from 100 to 150 feet apart. The cross arms are heavy and the butts are often placed in blasted holes in solid rock. Only a few freak poles have shown signs of decay as yet, and only once or twice has the lightning been known to set fire to the pole or crossarm. The line is not sectionalised. One line can carry all the load, so that as soon as trouble is found to be on either line, the entire load is thrown on the good line. Being on separate poles, trouble on one line does not cripple the other. So amply has the system been designed that it has not been found necessary to transmit at the rated voltage as yet, but current is transmitted at 40,000 volts by using taps in the windings of the transformers at the generating and receiving stations. This causes a saving in the expenses of locating and replacing broken down insulators for even the most up-to-date systems have breakdowns now and then from flaws in apparently good porcelain and stresses due to internal surges. The cables are arranged in an equilateral triangle by placing one cable at the top of the pole. The other two are on the crossarm. This formation is desirable to equalize the mutual induction of each wire on its mates and to facilitate transposition.

All the buildings and equipment of the system were designed to last and to accommodate large additional capacity. The available power at Upper Bonnington Falls is only partly developed even with the addition of another 8,000 h.p. unit, which is being installed at present. This last addition will be required to supply power for the electrification of the C.P.R. from Castlegar to Rossland. The substations are all built along the same plans. Separate rooms are provided for each bank of transformers, the high tension switching equipment, and the switchboard and operating room. No provision is made for elaborate systems of relays to disconnect lines when the voltage drops or the current is interrupted. The simple inverse-time-limit overload relays afford sufficient protection on both the high tension and feeder switches.

The accompanying illustrations of power house No. 2 give some idea of the difficulty with which it was erected. 70,000 cubic yards of solid granite had to be excavated for the forebay, powerhouse site and tail race. The building is of reinforced concrete and is not at all ugly or out of keeping with the natural beauty of its surroundings. The interior is roomy and provision is made in the present building for four units of 8,000 h.p. capacity each. Two of these are installed and in operation and a third is now being installed as mentioned before.

In this article I have endeavored to omit the quoting of capacity data and similar information as I have always found that it makes wearisome reading. Instead of detailing the equipment of the powerhouses and substations, which is pretty much standard and is familiar to most students interested in power plant construction, I have outlined some of the conditions under which this system was constructed and is now operated. Every little system has troubles all its own and it is these peculiarities which make the descriptions of plants and systems interesting.

THE MECHANICAL AND ELECTRICAL CLUB OF THE ENGINEERING SOCIETY

1. Name of Club.

The name of the Club shall be, "The Mechanical and Electrical Club of the Engineering Society." (The relation of this club to the Engineering Society is provided for in the revised constitution of the Engineering Society, adopted.

2. Membership.

(a) The membership of the Club shall be open to all students in Electrical and Mechanical Engineering in the Faculty of Applied Science and Engineering, University of Toronto. Such members do not require nomination or election.

(b) Others desiring to become members shall be elected by the Club. Such candidates shall be nominated at a regular meeting, the voting on this nomination to take place at the following regular meeting.

3. Divisions of Club.

The Club shall be divided into two sections, namely:

(a) A Senior Section consisting of members of the third and fourth years in Electrical and Mechanical Engineering.

(b) A Junior Section consisting of members of the first and second years in Electrical and Mechanical Engineering.

4. Officers.

(a) The officers shall consist of a chairman, a vice chairman, a third year councillor, a second year councillor, and a first year councillor.

(b) The chairman shall be a member of the fourth year and hold office on the Executive of the Engineering Society as provided in the Constitution of the Engineering Society.

(c) The vice chairmen shall also be a member of the fourth year.

5. Duties of Officers.

(a) It shall be the duty of the chairman to preside at all general meetings, call meetings for the election of an executive or for the transaction of any other business pertaining to the interests of the club. He shall enforce due observance of the constitution and by-laws, shall make no motion or amendment nor vote on any question or motion unless the club be equally divided when he shall give the deciding vote.

(b) The vice-chairman shall perform the duties of the chairman in the absence of that officer. He shall also preside at the meetings of the senior section, provide places for these meetings and arrange for topics of discussion. He shall also collect fees from the members of the fourth year.

(c) The third year councillor shall act as secretary to the club and also collect fees from the members of the third year. He shall keep a record of the proceedings of the club at the general and executive meetings. He shall also make mention in the minute book of the meetings of the two sections.

(d) The second year councillor shall act as treasurer, collect fees from the members of the second year and keep an account of all expenditures and receipts in an account and cash book. He shall also arrange the meetings of the Junior section and preside at such meetings.

(e) The first year councillor shall act as curator and shall also collect the fees from the members of the first year.

6. Election of Officers.

(a) The Chairman shall be elected at the annual elections of the Engineering Society.

(b) The vice-chairman, third year councillor and second year councillor shall be nominated at the last general meeting of the club, the elections to take place one week later.

(c) The first year councillor shall be nominated at the first general meeting of the fall term, elections to take place one week later.

7. Duties of Members.

(a) Members are requested to read papers before the club at the general meetings.

(b) It is the duty of all members to take part in any discussion.

(c) Papers presented shall become the property of the club.

8. Meetings.

(a) The general meetings shall be held once a month, alternately with the general meetings of the Engineering Society, such dates to be chosen by the executive of the Engineering Society. Meetings to commence at 4 p.m.

(b) The senior section shall hold their meetings on the first Thursday of the month at 8 p.m.

(c) The Junior section shall hold their meetings on the fourth Thursday of each month at 8 p.m.

(d) It is also recommended that these meetings be not addressed by an outside speaker, but that they take the form of open discussion in which everyone should take part. However, this is left to the discretion of the vice-chairman and second year councillor who are at liberty to form their own rules and regulations, provided that said rules and regulations meet with the favor of the executive of the Engineering Society.

9. Fees.

(a) The annual fee shall be twenty-five cents to members of the Junior and Senior sections.

(b) All fees shall be paid within the first academic month.

10. Alterations to Constitution.

Notice of motion regarding proposed alterations to the constitution shall be given at the previous meeting and a written notice of motion shall be handed to the secretary, voting to take place at the next general meeting.

By-Laws Relating to General Meetings

1. Rules of Order.

(a) The order of business shall be as follows: Opening, reading of minutes, nomination of members, reading of communications, reports of committees, election of members, unfinished business, new business, programme and closing.

(b) The chairman, or in his absence, the vice chairman, shall conduct the meeting, or in the absence of such officers a chairman pro tem shall be chosen by the club.

(c) The chairman shall be privileged to debate on all subjects upon calling any member to the chair.

(d) The minutes shall not be amended except to correct error in fact.

(c) Any member who wishes to speak shall rise and respectfully address the presiding officer. He shall confine himself to the question under discussion and avoid personalities.

(f) If two or more members rise to speak at the same time the presiding officer shall decide who shall speak first.

(g) A motion must be moved, seconded and repeated aloud from the chair before it is open for debate.

(h) Motions must be written out and handed to the secretary, signed by the mover and seconder.

(i) When a member is called to order he shall resume his seat until the point of order is decided.

(j) An appeal may be made at all times from the decision of the chair. The presiding officer shall put the question, "Shall the decision of the chair stand as the opinion of the meeting." Two-thirds vote of meeting is necessary to sustain the appeal.

2. Alterations to By-Laws.

The same procedure shall be adopted as is provided for in changing the constitution.

UNKNOWN ADDRESSES

The following is a list of graduates, regarding whose addresses we have not reliable information. Our readers will confer a favor if they will kindly advise us of the correct addresses of any of the men listed below:—

Abendana, E. M., '14; Alexander, J. H., '04; Allen, F. G., '07; Armour, R. H., '05; Bertram, G. M., '01; Binns, R. E., '13; Blair,

W. J., '02; Bowman, A. M., '86; Brackenreid, T. W., '11; Brown, D. B., '88; Brown, H., '11; Browne, E. W., '09; Bruce, W. J., '07 Campbell, A. W., '06; Campbell, R. J., '95; Campbell, A. M., '04; Campbell, A. J., '04; Cameron, M. G., '09; Carey, B., '99; Chambers, E. V., '14; Chantrell, E., '05; Charlebois, J. P. C., '08; Chisholm, D. C., '10; Christie, F., '06; Clark, J., '00; Coulter, G. P., '07; Darrich, J., '08; De Guerre, F. C., '11; Derham, W. P., '09; Dowling, F., '05; Elliott, J. C., '99; Evans, J. H., '11; Evans, S. D., '07; Foreman, W. E., '99; Forester, C., '93; George, R. E., '03; Gourlay, W. A., '03; Heebner, M. B., '11; Horton, J. A., '03; Hull, H. S., '95; Hunter, A. N., '08; Irwin, W. J., '10; Kay, E. W., '07; Kean, D. J., '09; Keefer, A. H. E., '09; Keys, W. R., '08; Lott, A. E., '87; Macdonald, F. R., '08; Macdonald, J. A., '10; Macdonald, J. B., '10; Macdougall, A. C., '01; McKay, A. G., '07; MacKay, J. T., '02; McKenzie, D. W., '05; McLellan, R. A., '11; McLeod, G., '09; McPherson, J., '06; McTaggart, A. L., '94; Malone, J. E., '08; Martin, F., '87; Matheson, W. C., '01; Maus, C. A., '03; Mennie, R. S., '02; Milligan, F. S., '10; Mitchell, L. C., '11; Montague, F. F., '06; Moore, F. A., '03; Munro, F. V., '03; Murray, J. D., '07; Niebel, E. H., '11; O'Brien, E. D., '05; O'Gorman, C. A., '09; Pae, A. W., '09; Parke, J., '04; Paton, T. K., '07; Paulin, F. W., '07; Pearson, C. L., '11; Pope, A. S. H., '99; Proctor, A. I., '09; Robertson, D. F., '03; Roaf, H. R., '00; Sanders, W. K., '06; Scott, W. A., '06; Shipley, A. E., '98; Smiley, R. W., '97; Smith, J. H., '03; Stamford, W. L., '08; Stevenson, W. H., '01; Taylor, W. V., '93; Thomas, V. C., '08; Wright, R. T., '94; Wilson, W. H., '10; Whelihan, J. A., '03; Villeneuve, T. L., '08.

INFORMATION RE CORRESPONDENCE FOR PRISONERS OF WAR IN GERMANY

1. Letters (letters should be left open) postcards and postal parcels should be addressed as follows:—

1. Rank, initials, name.
2. Regiment, or other unit.
3. British (or Canadian, French, Belgian or Russian) prisoner of war.
4. Place of internment.
5. Germany.

Place of internment should be stated always, if possible, and parcels cannot be accepted unless place of internment is stated. All addresses must be in ink.

2. Communications should be limited to private and family news and to necessary business communications, and should not be sent too frequently.

No references to the naval, military or political situation or to naval or military movements and organizations are allowed. Letters or postcards containing such references will not be delivered.

3. Friends of prisoners of war are advised to send postcards

in preference to letters as postcards are less likely to be delayed. If letters are sent, they should not exceed in length two sides of a sheet of note paper and should contain nothing but the sheet of note paper. On no account should the writing be crossed.

4. Letters cannot for the present be accepted for registration.

5. Postage need not be paid either on letters or parcels addressed to prisoners of war.

6. No letters should be enclosed in parcels, and newspapers must not on any account be sent. So far as is known there is no restriction on the contents of parcels; tobacco may be sent and will be admitted duty free but food stuffs of a perishable character should not be sent. Parcels should not exceed 11 pounds in weight.

7. Remittances can be made by money order to prisoners of war. Instructions as to how to proceed can be obtained from postmasters of Accounting Post Offices. The transmission of coin, either in letters or parcels, is expressly prohibited. Postal notes and bank notes should not be sent.

8. It must be understood that no guarantee of the delivery of either parcels or letters can be given and that the Post Office accepts no responsibility. In any case, considerable delay may take place and failure to receive an acknowledgement should not necessarily be taken as an indication that letters and parcels sent have not been delivered.

9. So far as is known, prisoners of war in Germany are allowed to write letters or postcards from time to time; but they may not always have facilities for doing so and the fact that no communication is received from them need not give rise to anxiety.

REUNION OF MONTREAL TOIKE OIKES

On the evening of May 7th a most enjoyable little reunion of about two dozen Montreal "School" men was held at the University Club, Montreal. Mr. Walter J. Francis occupied the chair and Dean Ellis the place of honor. At the conclusion of the dinner Dean Ellis proposed the toast to the "Toike Oikes at the Front" and reviewed some of the history of the School that was new to most present. Following the Dean, Mr. Ross expressed some felicitations while Mr. H. W. Fairlie, B.A.Sc., '10, who had just returned after a year's residence in Winnipeg, also spoke.

The annual elections were then held, and Mr. J. M. R. Fairbairn, '93, assistant chief engineer of the C. P. Ry., was elected president; Mr. W. D. Black, B.A.Sc., '09, vice-president, and Mr. W. H. Sutherland, B.A.Sc., '02, secretary-treasurer; while the old Advisory Committee of Messrs. J. M. Robertson, '93, D. C. Tennant, B.A.Sc., '09, L. R. Wilson, B.A.,Sc. '09, and C. W. B. Richardson, B.A.Sc., '07, was re-elected.

FAREWELL DINNER TO MEMBERS OF CLASS 1913

On the evening of May 7th the members of year 1913, residing in Toronto, held a farewell dinner at the Walker House for their members who are leaving with the Second Canadian Expeditionary Force. Messrs. Chas. Avery and N. F. Parkinson of the 15th Battery C.F.A., were present, and the year greatly regretted the inability of the others to be with them. Mr. E. R. Gray, president of the class, was the toastmaster. After each member had had an opportunity to make a speech or tell a story, a business meeting was held at which it was decided to form a Toronto Branch of the class.

The following were elected as officers:—John S. Galbraith as president; and R. L. Hearn, of 249 Dovercourt Road, Toronto, as secretary. Each member of the year is asked to keep in as close touch as possible with these officers.

The men of this year who have already left on active service are:—First Contingent, A. J. Gray, C. A. Bell, C. B. Ferris, E. S. Foulds, L. C. M. Baldwin, A. G. Gray, F. S. Rutherford.

Second Contingent—J. McV. Strathy, F. F. Howlett, C. R. Avery, C. E. Kilmer, N. F. Parkinson, H. Webster, and B. H. Segre.

C.O.T.C. CAMP

The Universities' Officers Training Corps camp which was held from May 3rd to May 15th, may be set down as a success in every way. Conceived as a preparation for self defence and carried out with the esprit de corps of college men, turned soldiers, all can agree with Colonel Lang when he expressed complete satisfaction with the results obtained.

The course of instruction was progressive in character. At first the men were put through the rudimentary exercises of squad drill. This was further developed until at the close of the camp the corps worked as a battalion. Practical examinations for those who had qualified on the written examinations, were also held.

For those who were not at camp an idea of the day's tribulations from the standpoint of a private may be of interest, and the fact that Professors Gillespie and L. B. Stewart were also privates in the strictest sense of the word is worthy of note.

Sometime in the middle of the night a bugle "goes" off and you find it is 5.45 a.m., and roll over only to be shortly awakened by the band playing some insane combination of futurist harmonies as it passes right through the lines. You have a few minutes' meditation and then the small fry get their innings. Sergeants and other non-coms. rush up and down the lines, "Double up men! Roll call. Always move at the double." Roll call and a short run are followed by the morning's ablutions and breakfast at 6.45 a.m. After cleaning the tents and taking physical exercise, everybody drills until noon. From 2 p.m. to 4.30 drill is continued and then everybody is off for the day.

The camp was inspected by Gen. Lessard on May 13th and again the same afternoon H.R.H. the Duke of Connaught critically inspected the corps. On Friday a field day was held followed by a march past before Gen. Hughes. This completed the work of the camp and on May 15th it was a bronzed lot of men that marched gaily up University Ave. to be dismissed until individually called on to serve their country by the call of duty.

ON ACTIVE SERVICE

The following "School" men have enlisted with the Second Canadian Contingent, in addition to those previously mentioned in Applied Science:—

J. L. R. Parsons, '01; E. R. Birchard, '09, with Eaton Battery.

E. G. MacKay, '10, with 91st of Hamilton.

A. L. Steele, '10, with Canadian Engineers at Ottawa.

E. F. Chesnut, '11, with No. 1 Co. 19th Battalion.

L. E. Jones, '11; A. M. Mackenzie, '14; G. H. Hally, '14, with 26th Battery at Kingston.

A. G. Scott, '15, with 42nd Regiment at Petawawa.

J. A. Tom, '15; I. M. Macdonell, '15; H. K. Wyman, '15; C. N. Geale, '15, and G. A. Gooderham, '15, with Aviation Corps at the Island.

C. C. Anderson, '16, R. Tyrwhitt, '16, with Stationary Hospital, C.E.F.

A. H. Macfarlane, '16; A. M. Thomas, 16, with No. 2 Co., 35th Battalion.

C. H. Wheelock, '16, with Machine Gun Det., 35th Battalion.

P. A. Durbrow, '17, with 8th Bde., C.F.A.

W. A. Bishop, '17; V. E. Ives, '17; F. R. Allan, '18; Machine Gun Det., 35th Battalion.

L. J. Deacon, '18, with 7th Bde., 26th Art.

H. W. Orr, '18, with 26th Battery, 7th Bde.

C. E. Kilmer, '13.

To date we have record of 69 "School" men with the First Contingent and 127 with the Second Contingent, exclusive of those enlisting with the Second University Overseas Company.

SCHOOL MEN ON THE CASUALTY LIST

Jeff Taylor, '08, has just been reported killed.

Lieut. E. A. Greene, B.A.Sc., '11, of 9th Battery, is reported missing.

Capt. D. H. C. Mason, B.A.Sc., '07, of 1st Brigade, 3rd Battalion, is reported missing.

Sergeant C. A. Bell, '13, of 3rd Brigade, 2nd Fd. Co'y is reported missing.

Pte. A. G. Code, B.A.Sc., '10, of Canadian Army Service Corps, reported seriously wounded.

Capt. R. Y. Cory, B.A.Sc., '08, Canadian Army Service Corps, 15th Battalion, reported prisoner.

Lieut. H. F. H. Hertzberg, '07, of 2nd Field Co., Canadian Engineers, has been wounded.

Lieut. G. E. D. Greene, B.A.Sc., '09, of 3rd Battalion, is reported prisoner.

Lieut. Herbert N. Klotz, '09, killed while fighting around Ypres.

One of the School men to receive recognition from the Imperial Government is M. B. Watson, 1910, who went over to England with the First Canadian Overseas Expeditionary Force. Shortly after his arrival at Salisbury he received a commission as 2nd lieutenant in the Royal Engineers, and is at present doing instruction work at Buxton, England.

While attending the School, Mr. Watson was connected with the 2nd Field Company, Canadian Engineers, receiving his corporal's stripes. On the outbreak of war he enlisted with his old company and trained with them at Valcartier, where he was, for part of the time, in charge of the local telephone system.

The accompanying photograph shows Lieut. Watson standing on the end of a barrel raft which was built under his instruction in 20½ minutes. Since leaving Toronto he has gained 20 pounds, and as may be seen from the photograph, has cultivated a very creditable eyebrow on his upper lip.

Editorial

UNIVERSITIES' OVERSEAS COMPANY

Following the suggestion of Capts. MacDonald and Molson, of McGill University to Hamilton Gault, that reinforcements for the Princess Patricia's Canadian Light Infantry be recruited from the C.O.T.C., the first University Overseas Company was formed at Christmas at McGill. It has been in training ever since with Capt. MacDonald in charge and Capt. Molson second in command. The subalterns being Capt. G. M. Smith, of Victoria College and Lt. D. G. Hagarty, '16. The first company is now in camp at Niagara and recruits are being called for the second company. It is hoped that the 110 men which Toronto is expected to contribute, may offer their services very shortly.

The company is not attached to any battalion and the work will not be wholly regular infantry drill but mutual instruction will be the strong point. As officers are very scarce in England it is the object of this company to qualify its men as officers so that they can obtain commissions when arriving in England. To date about 50 School men have enlisted and should any graduates be seriously considering going to the front no better opportunity could be offered them.

IRISH CHANNEL RAILWAY

In the November, 1913, issue of Applied Science appeared an article on the unifying of the British Empire by "A Railway Across the Irish Channel" proposed by H. G. Tyrrell, C.E., '86. This article at the time it was published was much discussed in British papers and magazines, and also in the British Parliament. The following extract from an article on this subject in Popular Science for October, 1913, sets out a few of the measures advocated by Mr. Tyrrell as precautions in case of war.

"The Irish Channel railway is of international interest and importance because it would form one link in the proposed Imperial Route connecting all parts of the British Empire. Over this route it is intended that travel should be conducted with the greatest possible speed, and in the event of war, Great Britain would have independent communication with all parts of the Empire and could receive supplies from Australia and New Zealand in about twenty-one days. Its course would lie across the Atlantic and Pacific oceans by way of Canada, instead of through the Suez Canal and the Mediterranean Sea, and past the ports of foreign countries. Food Supplies from Canada and the west would then arrive in Great Britain at ports on the west coast of Ireland, which in times of war, would be much safer than others further to the south or on the English Channel adjoining France."

The wisdom of this plan is now all too evident, though too late. However, when the war is over the northern Irish ports will doubtless be developed.

SIGNS OF THE TIMES

Great is the credit due Canada for weathering the difficulties of economic adjustment as she is. Money is accumulating rapidly and the change from the British to United States money market was effected without trouble. The chartered banks, which are the safety valve of Canada, are in an excellent position and extend credit when it is deserved. The agricultural prospects are good and trade is improving. Few mortgage payments, of either principal or interest, are in default. Manufacturers are cutting new trade channels, encouraging home demand, and increasing their exports. In short, everything indicates a period of prosperity for Canada.

MADE IN CANADA

We must not forget that it was upon German science that the trade of Germany was developed to such a marked degree. The very base of all their industries was science and particularly the science of chemistry. The standardizing of all products, the development of industries, the invention of new products, the utilization of by-products, etc., all depend on chemical research. It is, therefore, quite evident that for Canada to become a "Made in Canada" country the chemical engineer has a great future ahead of him and is bound to become more and more the power of commerce.

AVIATION

Toronto is one of the continent's busiest centres of aviation. But two weeks ago there was only one aeroplane around Toronto and now there are seven. In a few weeks Toronto has become the greatest flying centre on the continent, and it will not be long before the machines, motors and practically all equipment will be built here. Should the war establish the aeroplane industry on a firm footing in Toronto, the credit will be due to a few enterprising men, who have worked without any government help, such as other countries give. One of these men is J. A. D. McCurdy, '07, managing director of the Curtiss Aeroplane & Motors, Ltd., who is looking after the Curtiss-McCurdy flying school at Hanlan's Point. They have four machines that are used in the course of instruction. For the early training the flying boat and slow land machine are used, while for finishing the course in land flying a powerful tractor, making 85 miles per hour, is used. The final stages are performed in a 160 horsepower flying sea-plane. The school will accommodate a class of thirty at a time.

PERSONALS

School Men on Hudson Bay Railway—Le Pas Division—J. P. Gordon, '04, assistant chief engineer. Division No. 2, Goose Lake, Mile 137—A. L. McNaughton, '03, resident engineer. Division 3, Landing River, Mile 280—S. Hett, '06, resident engineer. Division 4, Landing River, Mile 280—J. W. Scott, '11, resident engineer.

John S. Galbraith, B.A.Sc., '13, has received a commission with the 10th Royal Grenadiers and is going into camp with them at the end of May.

E. E. Hugli, B.A.Sc., '14, is draughting for the Mond Nickel Co., Coniston, Ont.

C. N. Geale, B.A.Sc., '15, and **G. A. Gooderham,** B.A.Sc., '15, are in training with the Aviator Corps at the Island.

G. A. Colquhoun, '06, is estimating and designing engineer with the Hamilton Bridge Works. His address is 29 Sophia St., Hamilton.

T. G. Gravely, B.A.Sc., '11, is on shell inspection work with John Bertram & Sons, Ltd., Dundas, Ont. His address is Box 158, Dundas.

W. C. Blackwood, B.A.Sc., '06, has been appointed director of physics for the Central Technical Schools, Toronto.

W. A. Cowan, '04, formerly of the Intercolonial Railway, has been appointed to the staff of Mr. F. P. Brady, divisional engineer for the Transcontinental Railway at Cochrane, Ont.

A. P. Linton, B.A.Sc., '06, assistant chief engineer, Board of Highway Commissioners for Saskatchewan, last week addressed the Regina Engineering Society on the Construction of the Traffic Bridge at Saskatoon.

Mr. K. H. Smith, '11, has been appointed resident engineer for the Dominion water Power Branch at Halifax, N.S., to have charge of field investigations covering the water powers of the Province of Nova Scotia. The investigations are being carried on under a co-operative arrangement between the Nova Scotia Water Powers Commission and the Dominion Water Power Branch.

Readers of APPLIED SCIENCE will be glad to hear of the very interesting and unique water power exhibit which has been arranged by the engineers of the Dominion Water Power Branch in the Canadian Pavilion at the Panama-Pacific International Exposition. As this exhibit has been conceived and carried out entirely by "School" men, APPLIED SCIENCE is arranging for a special descriptive article which will appear in a forthcoming number.

The following "School" men have recently been appointed to the staff of the Dominion Water Power Branch, Department of the Interior:—

Harold Leach, '14; **George Woods,** '16; **J. T. Rose,** '15.

These men will all be attached to the staff of the Manitoba Hydrographic Survey, of which Mr. M. C. Hendry, '05, is chief engineer.

The Canadian Government has recently arranged to have a reconnaissance survey made of the water powers of the Yukon territory. This work will be carried on under the personal direction of R. G. Swan, B.A.Sc., '09, chief engineer of the British Columbia Hydrographic Survey.

NEW AMMUNITION COMPANY

The Montreal Ammunition Co., of which Mr. H. H. Vaughan is president and Mr. G. H. Duggan, '83, vice-president, is a newly organized concern that will manufacture brass cases for shrapnel and high explosive shells. Heretofore these cases have not been manufactured in Canada, but orders were filled in Detroit and other cities of the United States. The new company will use part of the plant of the Dominion Bridge Co. for its work. Mr. Duggan is general manager of the latter company, while Mr. Vaughan resigned his position as chief mechanical engineer of the C.P.R. to devote his time to the new concern.

OBITUARY

The death of Mr. T. Harry Mace, '05, occurred last week. For some time he has been associated with the patent office of the Dominion Government at Ottawa, and prior to this had a consulting practice here in Toronto. The deceased was also a member of the 3rd Field Company of Canadian Engineers.

We wish to convey our sympathy to Mr. A. V. Trimble, '04, in the loss of his beloved wife, who died suddenly on Sunday, May 2, at 94 Glendale Avenue.

Lieut. Herbert N. Klotz, '09

Following closely upon a letter written from northern France to the effect that he never felt better in his life and was enjoying himself, came a message that shattered all hopes of a safe return. Lieut. Klotz was always an ardent military man, and while attending Harbord Collegiate, took an active interest in the cadet movement. After graduating from the "School" he was engaged as a chemist with the Gutta Percha & Rubber Company, and was with them until he received a commission with the Mississauga Horse, and enlisted with the First Contingent. He is survived by his father, Mr. E. W. Klotz, of 40 Sussex Avenue.

APPLIED SCIENCE EXAMINATION RESULTS, 1915

PROFESSIONAL DEGREES

Degree of Civil Engineer—

G. A. Bennett, B.A.Sc., '10 (C.E.); J. B. Challies, '04 (C.E.); E. A. Davison, B.A.Sc., '05 (C.E.); Angus Smith, '94 (C.E.); D. S. Stayner, B.A.Sc., '10 (C.E.).

Degree of Mining Engineer—

A. D. Campbell, B.A.Sc., '11 (M.E.); B. Neilly, B.A.Sc., '08 (M.E.).

Degree of Mechanical Engineer—

A. M. Campbell, B.A.Sc., '05 (M.E.).

Degree of Electrical Engineer—

C. E. Palmer, B.A.Sc., '11 (E.E.).

Degree of Master of Applied Science (M.A.Sc.)—

C. R. Avery, B.A.Sc., '13; N. F. Parkinson, B.A.Sc., '13; C. S. Robertson, B.A.Sc., '13; O. Rolfson, B.A.Sc., '07; G. E. Treloar, B.A.S.c, '14.

SCHOLARSHIPS

The Boiler Inspection and Insurance Co.'s scholarship for general proficiency in mechanical engineering for the third year is awarded to L. L. Youell.

STANDING GRANTED ON ACCOUNT OF ACTIVE SERVICE

The following candidates have been granted standing in their respective years on account of having enlisted for active service:

First Year—T. B. Jack.

Second Year—W. H. Aggett, W. B. Andrew, W. D. Armstrong, W. H. Bauer, W. A. Bishop, E. S. Byers, E. R. Dafoe, P. A. Durbrow, E. B. Dustan, C. Hewson, J. H. Legate, F. A. McKinley, A. F. Norris, C. H. Smith, J. Ward, J. F. Young.

Third Year—C. C. Anderson, T. E. Armstrong, S. K. Cheney, T. A. Daniels, C. W. Edmonds, W. F. Hadley, F. J. Matthews, A. R. Mendizabel, F. S. Merry, H. B. Norwich, V. R. Pfrimme, W. W. Ritchie, C. Smythe, H. Stewart, A. A. Swinnerton, A. M. Thomas, A. B. Whaley, C. H. Wheelock, J. S. Wilson,

Fourth Year—R. M. Arthur, H. J. Burden, W. G. French, R. D. Galbraith, M. S. Haas, I. M. Macdonell, K. D. McDonald, E. V. McKague, W. D. Powell, W. E. Raley, G. W. Rutter, A. G. Scott, W. G. Shier, R. B. Sinclair, J. A. Tom, J. N. Williams, H. K. Wyman, B. M. Morris.

The degree of B.A.Sc. was conferred upon the following at a special convocation held last February: F. D. Austin, N. H. Daniel, W. E. Lockhart, W. B. Redman, L. B. Tillson.

Candidates whose names are followed by brackets must pass supplemental examinations in the subjects indicated:—

First Year

Civil Engineering—

Honors—J. C. Angus, J. C. Aykroyd, J. M. Breen, H. R. Burton, W. L. Clairmont, C. P. Coatsworth, O. G. Darling, H. J. Elliott, H. W. J. Fairclough, J. A. Garvi, R. B. Gordon, H. Harrison, S. H. Johnston, F. T. Julian, J. A. Langford, N. G. McDonald, P. L. McGavin, L. McGee, R. Mitchell, J. R. Mitchener, T. H. Norval, G. M. Pearce, G. V. Rayner, J. Roosky, W. L. Sagar, M. Samuels, C. R. Scott, D. G. Scott, G. E. Steele, H. G. Thompson,

Pass—E. Birdsall, W. G. Brown, F. W. Campbell, F. D. Ellis (algebra), N. H. Kearns, G. K. MacKendrick, K. J. McEachern (trigonometry, anal. geom.), C. R. Maddock (algebra), W. J. Parker, S. H. Pepler (elem. chemistry), D. A. Robertson, F. W. Simpson, C. H. Stalker, A. K. Sweetman (alg., trig.), F. H. Taylor, C. C. Wimperly.

Mining Engineering—

Pass—N. Bowman, C. A. Richardson.

Mechanical Engineering—

Honors—F. J. Booz, M. G. Lymburner, P. F. McIntyre, S. A. McLennan, J. A. Simmers, M. L. V. Weir.

Pass—R. A. Connor (trig.), M. E. Dickenson (anal. geom., German), H. T. Gorrie (alg., trig.), H. J. McCreary (alg.), J. H. Peters (trig., anal. geom.), W. D. Robertson (elec. lab., trig.), W. J. Scott, (anal. geom.), P. E. Williams (alg.).

Architecture—

Honors—G. R. Gouinlock, T. J. Young.
Pass—W. A. Mollard.

Analytical and Applied Chemistry—

Honors—J. E. Fasken.
Pass—J. E. T. Musgrave (trig., anal. geom.), M. D. Schell (alg.).

Chemical Engineering—

Honors—J. A. Affleck, R. D. Affleck, J. H. Forman, G. E. Goble.
Pass—K. H. Chamberlain (elec. lab.).

Electrical Engineering—

Honors—C. K. Duff, K. S. Gemmel, J. P. McClelland, E. W. McLeod, W. H. Orr, G. R. Shephard, J. M. Souter, G. F. Tracy, H. S. Weldn, C. M. Willey.

Pass—W. D. Brown, G. F. Bryant (anal. geom.), J. W. Gardner (trig., anal. geom.), F. E. Johnston, K. D. Kayler (trig.), G. L. Macpherson, C. J. McNamara, J. H. McVean, T. W. Penhale (trig.), W. M. Smith (trig.), G. B. Wigle, F. A. Wood, W. G. Woonton (alg.).

Second Year

Civil Engineering—

Honors—A. E. Berry, R. S. C. Bothwell, G. A. H. Burn, F. C. Christie, R. A. Crysler, W. P. Dale, R. R. Hawkey, U. C. Holland, C. A. Hughes, W. H. Hunter, R. W. Hurlburt, R. E. Jones, J. R. McLean, R. C. Manning, H. A. Parr, C. L. Pool, W. D. Proctor, R. D. Ratz, G. E. Stephenson, C. E. Tilston, V. Topping, G. E. Waite, R. S. Warwick, L. E. Willmott, G. Wood, N. C. Wood.

Pass—O. V. Ball, H. F. Coon, E. H. Corman, F. C. Darch (mineral lab., hydrostat.), H. L. Dowling, J. A. Fraser, J. R. Gilley (Fr.), W. K. Greatrex. L. H. Ingersoll (optics), E. W. Johnston (calc.), W. J. Le Clair, G. A. McEwen, F. McGinn, F. L. Mitchell, E. L. Moorehouse, (Fr.), C. E. Newman (sph. trig., survey), H. R. Nicholson, J. E. O'Brien, W. J. Peace, G. P. Pearson, T. J. L. Ryan (survey), L. R. Shoebottom, G. H. Sohn (calc.), G. W. G. Stevenson (calc.), R. E. Taylor, A. P. Thomson, E. Thompson, G. A. Webb (Fr.), G. A. Whately.

Mining Engineering—

Honors—E. R. Gilley, G. Hanmer, H. L. McClelland, J. E. Sharman.

Pass—E. R. Howes (calc., inorg. chem.), H. D. Wallace (calc.).

Mechanical Engineering—

Honors—E. Bell, M. G. Henderson, J. D. Relyea, A. M. Snider, C. E. W. Tindale.

Pass—A. B. Harris, S. G. McCandish, (calc.), E. McIlhargey (theo. of mechan., bank. and fin.), A. W. Swan (hydrostat.), D. D. Vaughan (calc.).

Architecture—

Honors—E. W. Haldenby, A. S. Mathers, H. R. Watson.

Pass—J. Banigan (calc.), F. R. Gibson (ord. of arch.), C. C. Thompson.

Analytical and Applied Chemistry—

Honors—J. V. Dickson.

Pass—O. G. Lawson (phys. chem., bank. and fin.), G. G. MacDonald (elec.), E. J. Tyrrell.

Chemical Engineering—

Pass—A. G. Knight (calc., metall.).

Electrical Engineering—

Honors—R. A. Barbour, G. E. Booth, F. M. Bryans, C. E. Burton, J. C. Colleran, C. E. Harrop, R. D. Huestis, G. F. Hutcheson, W. J. Nichol, E. W. Smithson, O. W. Titus, A. A. Tufford, J. S. M. Wallace.

Pass—J. Ballinger (calc.), S. B. Bingham, (calc.), H. S. Brown (calc.), S. W. Bumstead, N. Burwash (calc.), R. T. Eyre, D. E. Ferrier, J. I. Gram (calc.), A. F. Hanly (calc., theo. of mech.), M. Johnston (calc., optics), L. Levesque, W. A. R. Offerhaus, H. Reed, H. A. Tuttle.

Third Year

Civil Engineering—

Honors—E. B. Allan, H. A. Babcock, L. F. Barnes, W. L. Dobbin, J. H. Eastwood, M. Gurofsky, O. Margison, W. B. Mitchell, C. H. Ney, J. E. Pringle, S. R. Ross, W. B. Scott, R. L. Seaborne, R. L. Sievewright,

Pass—B. W. Bemrose (survey), E. Crosby, R. S. Dale, L. F. Gaboury (astron. and geod.), D. B. Gardner (astron. and geod.), D. G. Hagarty, G. C. Hagedorn (astron. and geod., theo. of struct.), R. M. Hare (astron. and geod., hydraul.), L. W. Harren, (theo. of struc.), C. E. Hastings, K. D. Jackson, J. R. Kirby, R. W. Kirby, L. A. Lee (astron. and geod.), J. R. McColl, E. A. O'Collaghan, N. L. Powell (theo. of struc., calc.), H. C. Rose (astron. and geod., hydraul.), G. B. Snow, R. M. Speirs (astron. and geod., theo. of struct.), F. S. Storms, J. A. Sureda, J. E. Tremayne (least sq., theo. of struc.), R. C. Ward.

Mining Engineering—

Honors—B. A. McCrodan.

Pass—F. W. Norton.

Mechanical Engineering—

Honors—J. R. Chapman, R. W. Kirn, J. C. Newcombe, J. P. Russell, H. A. Washington, L. L. Youell.

Pass—H. E. Breuls (alt. curr.), J. N. Cunningham, J. L. Delisle (thermo., calc.), A. Fleming, R. A. Macdonald (thermo., mech. of machin.), J. M. Watson.

Architecture—

Honors—R. T. C. Hoidge.

Pass—L. Husband, W. S. Kidd, G. H. Schwartz, J. L. Skinner (theo. of struct.), A. F. R. W. Swinnerton (theo. of struct., photo.).

Analytical and Applied Chemistry—

Honors—W. G. Birrell, N. B. Brown, J. E. Clark.

Pass—F. W. Ward.

Chemical Engineering—

Honors—D. Boyd, C. E. Oliver.

Pass—S. J. Krug.

Electrical Engineering—

Honors—K. Cumming, L. L. Cunningham, L. G. Dandeno, E. G. Gurnett, G. E. Nott, A. R. Wells, H. S. Weppler.

Pass—F. C. W. Ball, F. W. Booth (thermo., mech. of machin.), R. L. Flegg, (thermo.), R. A. Fraser (hyd. lab.), S. J. Hubbert (elec. chem.), J. Kelleher (thermo., mech. of machin.), G. F. King (thermo., alt. curr.), T. R. Manning, J. Richmond, S. W. Ross, W. A. Smalser, A. E. Widdicombe.

Fourth Year

Civil Engineering—

Honors—G. A. Arksey, P. Bennett, R. H. H. Blackwell, E. D. G. Brouse, L. R. Brown, E. M. Buchanan, J. D. Cook, A. B. Crealock, E. V. Deverall, W. L. Dickson, G. A. Downey, W. R. Da Costa, W. R. Fraser, W. J. Fulton, E. R. Grange, C. E. Hogarth, C. W. H. Jackson, G. W. F. Johnston, R. E. Laidlaw, G. J. Lamb, H. O. Leach, W. E. Longworthy, C. T. Lount, R. G. Lye, C. A. Macdonald, H. E. Macpherson, W. R. McCaffery, C. R. McCort, J. P. McDonald, D. F. McGugan, W. H. Meitz, G. Mitchell, M. A. Neilson, H. S. Nicklin, R. A. Paul, H. M. Peck, C. F. Porter, J. E. Porter, G. Rankin, A. A. Richardson, H. M. Rowe, E. H. Scott, R. G. Scott, J. H. Shaw, C. N. Simpson, H. B. Thompson, L. P. Vezina, P. E. Weir, C. W. West, J. C. Wilson, H. A. Wood.

Pass—L. S. Adlard, A. C. Anderson, F. N.D. Carmichael, J. C. Christner (3rd year theo. of struct.), R. M. Cockburn, A. C. Evans, H. S. Falconer, J. W. H. Ford, C. N. Geale, (3rd year theo. of struct.), G. A. Gooderham, E. D. Gray (conditioned), G. S. Gray (thermo., 3rd yr. hydraul.), C. Hayward, E. H. Jupp, J. T. Mogan (hydraul. turb.), E. B. O'Connor, W. M. Omand, L. P. Pearce, S. M. Peterkin, C. C. Rance, J. T. Rose, J. S. Sheehy.

Mining Engineering—

Honors—W. T. Hall, J. E. Hanlon, L. T. Higgins, J. B. Stitt, J. E. C. Stroud.

Pass—E. R. Emmerson, D. S. Halford, R. D. Jones (metall., 3rd yr. metal.), F. L. Mills, J. M. Muir, J. Ross (thesis, metall.),

Mechanical Engineering—

Honors—C. G. Davey, R. H. Lloyd, W. R. McGie, A. N. Payne, F. G. Reid, A. S. Robertson, A. H. Smyth.

Pass—J. Gray, J. D. Stone, G. D. Tillson (hydraul. turb., thermo.).

Architecture—

Honors—R. W. Catto, T. S. Graham, A. Morris.

Pass—J. J. Davidson, G. R. Edwards (calc.), H. P. Frid (modelling).

Analytical and Applied Chemistry—

Honors—H. Kohl, W. D. Morris, W. Uffelmann.

Chemical Engineering—

Honors—J. E. Breithaupt.

Pass—L. G. Glass, F. J. Relyea.

Electrical Engineering—

Honors—W. V. Ball, T. R. Banbury, V. A. Beacock, H. M. Black, G. P. Davidson, W. A. Dean, J. Dibblee, R. V. Elliot, W. H. R. Gould, G. A. Ironside, G. W. Lawrence, E. M. Monteith, A. C. Ross, E. W. Savage, W. A. Steel, G. C. Storey, A. N. Suhler, A. L. Ward.

Pass—A. R. Birrell, W. H. Borus, H. C. Budd, F. H. Chandler (thermo.), W. W. Code (thermo.), D. T. Flannery, G. D. Gray, G. E. Griffiths, T. P. Ireland, K. A. Jefferson, C. M. Jones, C. R. Keys, J. S. McIntyre, E. T. Martin, (3rd year elec. chem.), W. P. P. Purdy, W. E. Russell (elec.), N. F. Seymour, A. N. Taylor.

Supplemental Examinations Passed

The following candidates have passed supplemental examinations in subjects within the brackets:—K. W. Jamieson (elec. chem.), R. A. Cross (trig., elec. lab.), W. B. Honeywell (elec. and mag.), G. S. Stratford (optics), B. MacKendrick (3rd yr. theo. of struct.), D. Sutherland (elec.), E. M. Abendana (4th yr. theo. of struct.), S. B. McGill (thesis), A. H. Parker (thesis).

Supplemental Examinations to be taken—
K. W. Jamieson (trig.), G. S. Stratford (calc.).

DIRECTORY OF THE ALUMNI

Douglas, W. E., '02, is secretary-treasurer of the McKnight Construction Co., Toronto.

Dowling, F., '05, is with the Manitoba Bridge and Iron Works, Winnipeg.

Downing, F. H., '11, whose home was at Lucan, Ont., is with the Manitoba Bridge and Iron Works, Winnipeg, when last heard from.

Duff, A. R., '09, is chemist for the Dunlop Tire and Rubber Goods Co., Toronto, in the rubber department.

Duff, M. O., '09. His last address with us is 4 Hughson St. S., Hamilton, Ont.

Duff, W. A., '01, is engineer on bridges for the Intercolonial Railway Co., Moncton, N.B.

Duggan, G. H., '83, is vice-president and chief engineer of the Dominion Bridge Co., and chief engineer of the St. Lawrence Bridge Co., Montreal.

Dunbar, W. B., '11, is with E. A. James, engineer for York County Highway Commission, Toronto.

Duncan, J. M., '10, is engineering-lieutenant, R.N., on H. M. S. "Victory" for the duration of the war.

Duncan, W. G., '13, has Port Dover, Ont., as his home address.

Dundass, C. S., '06, is at Lachine, Que., with the Dominion Bridge Co., as Draughtsman.

Dunlop, R. J., '02, is a member of the National Refining Co., dealers in dental supplies, Toronto.

Dunn, T. H., '93, is Chief Reclamation Engineer, Dominion Water Power Branch, Dept. of Interior, Ottawa.

Duthie, L. J., '09, is with the Porcupine Crown Mine, Timmins, Ont.

Dyer, F. C., '08, is lecturer in mining engineering, University of Toronto.

Eagleson, F. M., '08, is engaged in civil engineering, surveying and municipal work at Winchester, Ont.

Eason, D. E., '01, is division engineer on the construction of the Trent Valley Canal, at Peterborough, Ont.

Eckert, C. H., '11, lives at 434 Queen's Ave., London, Ont.

Eadie, L., '10, has 90 Laughton Ave., West Toronto, as his address.

Edwards, W. M., '02, is a member of the firm of Duff & Edwards, engineers and surveyors, Lethbridge, Alta.

Edwards, H. C., '14, lives at King Edward Apts., 192 Jarvis St., Toronto.

Edwards, C., '08, is with the Sewer Section, Department of Works, city of Toronto.

Elder, A. J., '04, is with the Department of the Interior, at Ottawa, in the Topographical Surveys Branch.

Elliott, C. F., '11, is enrolled at Osgoode Hall, supplementing his engineering course with one in law.

Elliott, G. R., '11, is with the Hydrographic Surveys Branch, Department of the Interior, at Calgary.

Elliott, H. F., '14, lives at Norwood, Ont.

Elliott, J. A., '14, is Assistant Engineer, B. C. Hydrographic Survey, Dominion Water Power Branch, Department of Interior, Nelson, B.C.

Elliott, H. P., '96, is a consulting engineer with offices in London and Toronto.

Elliott, J. A., '11, is engaged as chemist with the Castner Electrolytic Alkali Co., of Niagara Falls, N.Y.

Elliott, J. C., '99, whose home is at Kelso, Ont., has no other address with us.

Ellis, S. D., '14, sailed on Dec. 22nd, 1914, from Valparaiso, S.A., with a large party of volunteers to join the British Army in Europe.

Emery, V. H., '10, is Mine Superintendent, Hollinger Mines, Timmins, Ont.

Empey, J. M., '02, is with the Department of Public Works, Calgary, as district engineer and surveyor.

Evans, J. H., '11, has no address with us.

Evans, S. D., '07, has no other address than his home at Leamington, Ont., upon our lists.

Evans, S. L., '08, was engaged in land surveying at Kamsack, Alta., when last heard from. His home is at Corinth, Ont.

Evans, W. J., '10, is in the employ of the Canadian Westinghouse Co., at Hamilton, Ont.

Ewart, J. A., '94, resides in Ottawa, Ont., where he has an architectural practice at 415 Booth Building.

Ewart, F. R., '07, is in Toronto, with the Toronto Hydro-Electric System.

Ewing, E. O., '08, is in Toronto with Frank Barber, bridge and structural engineer, 58 Adelaide St. E.

Eyres, H. E., '14, when last heard of was at 168 Antrim St., Peterborough, Ont.

Fairbairn, J. M. R., '93, is with the Canadian Pacific Railway as assistant chief engineer, located in Montreal.

Fairchild, C. C., '92, has a practice as consulting engineer and surveyor, Teglar Block, Edmonton, Alta.

Fairlie, H. W., '10, is in the employ of the Northern Electric & Mfg. Co., in their Winnipeg office.

Falconer, F. S., '00, is with the Topographical Survey Branch, Department of the Interior, Ottawa.

Falls, O. M., '14, is at London, Ont., with the Canadian Inspection Company.

Fargey, T. A., '09, was with the Canadian General Electric Co. at Winnipeg when last heard from.

Farrell, K. A., '11, is assistant engineer with Speight & Van Nostrand, Toronto.

Farquharson, W., '11, is with the Geo. R. Cook Co., contracting engineers, of Detroit.

Farelly, T. J., '11. We have not his present address. His home address is Alma, Ont.

Fear, S. L., '06, is in charge of the gas engine department of the Canada Foundry Co., Toronto.

Fensom, C. J., '03, is works engineer Otis-Fensom Elevator Co., Hamilton.

Ferguson, C. R., '10, was draughtsman with the Dominion Bridge Co., Toronto, when last heard of.

Ferguson, D. G., '14, is with the Ontario Hydro-Electric Power Commission, Toronto.

Ferguson, G. H., '05, is assistant engineer to the Commission of Conservation, Canada.

Ferguson, J. B., '09, is in Winnipeg with the C. N. Ry. in the Engineering Department, Maintenance of Way.

Ferguson, J. W., '10, is in Brampton at present.

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